Materials Engineering Branch

TIP*

No. 131 A Technique for Measuring the Junction Temperature of LEDs

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A test method for LEDs that was developed for COBE may be of general interest. The test involved determining the junction temperature of LEDs used in the mechanical mirror transport mechanism on COBE/FIRAS. The junction temperature was determined as a function of various forward currents in order to optimize the LEDs service lifetime. An LED dissipates heat at the same time that it emits light, causing its junction temperature to be higher than the LEDs case temperature. The wavelength of this emitted light and the optical efficiency of the LED are both dependent on the junction temperature of the LED. By experimentally measuring this dependence on temperature, the junction temperature of the LED can be determined.

The first step in measuring the temperature of an LED junction requires calibrating the temperature of the junction. The spectral output of the LED can be characterized by determining the optical flux versus wavelength. For this work, the spectral output is measured using an Optical Multichannel Analyzer. For small enough forward currents, junction heating is negligible, and the spectral output of the LED is a function of the case temperature of the LED. In particular, the wavelength of maximum optical flux and the ratio of this maximum optical flux to forward current (which is proportional to optical efficiency), are functions of the junction temperature. By using a heater, the spectral output of an LED can be measured at different temperatures. The junction temperature can now be calculated from the wavelength of maximum optical flux and the ratio of maximum optical flux to forward current.

Now that the temperature of the junction can be measured using its light output, an LED can be operated at higher forward currents and the temperature of the junction can be calculated.

The technique described above was used to measure the operating junction temperature of several LEDs used in the mirror transport mechanism of COBE/FIRAS.